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ABSTRACT

This study examined the mobilization and implementation stages of introducing microcomputers into elementary and middle schools in a majority adopter (i.e., schools which began implementing microcomputers for instruction in 1983-84) school district. Data collection included structured interviews with school district staff and principals; unstructured interviews with principals, school librarians, and teachers; naturalistic observations in regular classrooms and computer laboratories; numerous informal interviews and observations with the teacher designated as a key informant for each school; content analysis of historical documents; compilation of computer usage statistics; and use of a questionnaire to measure levels of concern felt by administrators and teachers toward microcomputers. Several conflicting major themes emerged from the data: resistance to innovation; strong grassroots support for microcomputers; fear of microcomputers; high motivation to use microcomputers; the influence of early adopter school districts; and the importance of the individual in the implementation process. The data also revealed characteristics of the implementation process that contributed to and detracted from institutionalization of microcomputers by the district. It was concluded that, due to their technical nature, the potential of microcomputers to enhance the educational delivery system has not always been realized, and several factors facilitating and hindering implementation were identified. (42 references) (Author/MES)

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Ethnographic Methods for Studying Microcomputer Implementation in Schools

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Abstract

During the early 1980's there was widespread demand for the integration of microcomputers into the instructional delivery system at all grade levels. Microcomputers represented an innovation with a potential to have a major impact upon education, but there were no clear guidelines about how school districts should implement them. In order to understand the process by which an innovation was introduced into an educational setting, previous researchers identified the need to examine the process at the school district level in three phases: mobilization, implementation and institutionalization.

In this study the mobilization and implementation stages of introducing microcomputers into a majority adopter school district were examined. The research was conducted as a multiple-site case study using structured and unstructured interviews, naturalistic observations, content analysis of historical documents, computer usage statistics, and stages-of-concerns data. Interaction within the institutional context, characteristics of the innovation, and concerns of individuals were examined within the loosely coupled operational units of a school district: the central office, schools, and classrooms.

The use of ethnographic data collection techniques produced a rich reservoir of information in which several conflicting themes were found. The data revealed resistance to innovation, strong grassroots support for microcomputers, fear of microcomputers, high motivation to use microcomputers, the influence of early adopter school districts, and the importance of the individual in the implementaton process. Characteristics of the implementation process that contributed to and detracted from institutionalization of microcomputers by the school district in the study also emerged from the data.

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Background

The clarion call of the early 1980's was for the widespread integration of microcomputers into the instructional delivery system of education at all grade levels. During this time, microcomputers became affordable for instruction and had the characteristics of an innovation defined to be "a practice or plan new to a particular school or local educational agency. . . [and] because it is new, requires some degree of modification or change in behavior of the principal actors" (Berman and McLaughlin, 1974, p.1). Microcomputers represented a new and different technology with the potential to have a major impact upon education, but there were no clear guidelines or precedence about how to implement them for district-wide instruction. While PTA's held bake sales to purchase microcomputers, prestigious national organizations such as the National Council of Teachers of Mathematics (NCTM) called for integration of microcomputers into all aspects of the curriculum and stated that widespread use of computers would significantly change the emphasis of education from product to process (NCTM, 1980). There was a concurrent public perception that schools were in trouble and that microcomputers could be used to modernize and improve the instructional delivery system (OTA, 1982).

All of these factors created a tremendous pressure on school districts from the grass roots level and from the national and state levels to introduce computers for instruction. It quickly became apparent that school district-wide introduction of this new technology required dealing with significant technological and financial issues. It required a massive commitment of time, staff development, curriculum changes, expenditure of large amounts of money, and redistribution of resources. Ironically, however, the largest obstacle encountered during the introduction of microcomputers for instruction turned out to be the acceptance of the innovation by the people involved. Applying the designation by Rogers (1983) of innovation adopters, the innovators (first 2.5%) began using microcomputers for instruction in education during 1978-80 followed by the early adopters (next 13.5%) during 1980-83 The majority adopters (next 68%) began implementing microcomputers for instruction in 1983-84.

Implementation is difficult to study because of its complex and evolutionary nature, but it is important to study because it illuminates the consequences of policy (Pressman & Wildavsky, 1984). In examining the process by which an innovation is introduced into an educational setting, Berman and McLaughlin (1978) identified three phases: mobilization, implementation, and institutionalization. Past research revealed that implementation of an innovation leading to institutional change does not take place unless the institutions and individuals involved in the process had both the willingness and the capability to change.

Educational settings are particularly resistant to change. There is a regressive tendency to revert back to pre-existing patterns of behavior unless all of those affected by the process participate in its development (McLaughlin & Berman, 1978). Unlike other settings in which the primary problem is to succeed in having an innovation adopted, in education the decision to adopt is only the beginnning of a highly unstable and variable process that can best described as evolutionary (Miles, 1964). Obtaining a precise description of implementing an innovation in an educational setting requires examining the institutional context (Berman & McLaughlin, 1978), the impact on the setting in terms of organizational change (Miles, 1964; Havelock, 1969; Elmore, 1978; Firestone & Herriott, 1982), and the concerns and participation level of the individuals involved (Hall, George & Rutherford, 1979; McLaughlin & Berman, 1978). Since the operational units within a school district are the school district, the individual schools, and classrooms (Berman & McLaughlin, 1974), all of which enjoy a high degree of autonomy (Weick, 1976), any meaningful analysis of implementation must look at each operational unit.

This study described the process of implementing microcomputers for instruction in the elementary and middle schools of a majority adopter school district. The philosophy of the selected majority adopter school district toward innovation was best expressed by the county motto "I byde my time." During the 1982-83 school year, school district officials made the decision, with the approval of the local School Board, to introduce microcomputers for instruction in three of its twenty-three elementary schools and in all four middle schools of the school district starting with the 1984-85 school year. There had been prior use of microcomputers for instruction in the high schools, but none in grades K-8. The district was in the position of being able to implement this decision using district-wide planning that drew from the set of computer implementation models available from neighboring districts. Several were innovators and early adopters, using microcomputers for instruction in their elementary and middle schools during the past five years.

Research Design

Implementation of a technological innovation like microcomputers for instruction involved many activities: acquistition of the necessary computer hardware and software, staff development to support the innovation, curriculum development to incorporate the innovation, and participant willingness to use the innovation. These activities do not proceed in a linear sequence but are both simultaneous and iterative. Because implementation is a dynamic process that involves the interaction of institutions and individuals, the decision was made to adopt the qualitative paradigm as the framework to study the district-wide implementation of

microcomputers for instruction. Within this paradigm a field-based methodology was chosen as the most appropriate approach for studying this process within the schools in a school district.

In recent years the field-based approach has become more prominent in educational research. "The orientation of field-based research is to attempt to understand schools in terms of the complex patterns of social interactions. It focuses upon the 'culture' of school life... data are collected in a 'natural setting' while schooling and the social interactions... are taking place" (Popkewitz, 1981, p.1). The field-based methodology allowed the researcher to analyze the implementation of microcomputers for instruction as it was understood by the administrators, teachers, and students of the school district (Rist, 1982).

In their review of the evaluation literature pertaining to educational innovations up through 1978, Berman and McLaughlin cited evidence that it was inappropriate to attempt to measure the effects of implementing an innovation using quantitative data. Past attempts to tie student outcome data to a particular innovation produced tenuous causal links at best (Berman and McLaughlin, 1978, p.1). Similarly, collection of survey or anecdotal data from school district personnel as a means of measuring the results of an innovation have proven equally unsuccessful in providing a realistic picture of the actual implementation of the innovation. "Much of the literature on change in education consists of single-case studies that evidence little methodological sophistication - research characterized as ...'show and tell' local education authority project reports...containing descriptions of 'exemplary projects' or 'innovative' programs" (Berman and McLaughlin, 1974, p. 3). Therefore, the most appropriate research strategy to use to capture the essence of a dynamic process like implementation was a phenomenological approach (Rist, 1977) using purely descriptive data (Berger & Luckmann, 1967) gathered from naturalistic observations (Becker & Geer 1957; Spradley, 1980), structured interviews (Spradley, 1979), and content analysis of historical documents (Webb et al, 1981) by someone outside of the school district (Merton, 1972).

This research was conducted as a multiple-site, case study using naturalistic observations, structured and unstructured interviews, content analysis of historical documents, computer usage statistics, and teacher concerns data. All research activities were done with the permission of and in coordination with the public school officials. The observations were conducted in the natural classroom and computer labs of three pilot schools, two elementary and one middle school. The research was conducted over the six month period from January to June, 1986.

Sample Selection. The school district coincided with a county local government unit encompassing 527 square miles of land area with a total population of approximately 70,000 people and a median family income of $43,393 as of April, 1986. Until recently, the county had been mostly rural, but with a rapidly expanding population migrating from the neighboring county, it was quickly becoming suburban with the attendant new demands on its school system. Demographic data obtained from the county planning office revealed that the county had a population that was predominantly white, with less than 10% black and less than 5% other minority members combined. It was located one county removed from a major metropolitan area, and its eastern side was rapidly becoming a suburban extension of the metropolitan area. It was representative of school districts in the second ring of suburbanization around a major metropolitan area. The 22 square miles in the eastern part of the county accounted for 33,000 members of the total population. In the center of the county was a small city of 10,000 people making up the county seat. The remainder of the county population was spread over approximately 500 square miles of rural land. The school district with an enrollment of 13,000 students from both a rural and suburban constituency was in the upper 3% of school districts by size in the country and fell within the third of six class sizes used by National Center for Educational Statistics to classify school districts by size.

The research population for this study was made up of district staff, school staff, and students involved with the implementation of microcomputers for instruction in the elementary and middle schools. The district staff were selected from recommendations by other staff members, based upon their knowledge of and participation in the process of implementing microcomputers in instruction.

Gaining Access to the Population. Permission to conduct this study was granted by the Assistant Superintendent of Instruction in agreement with the school principals and the classroom teachers. A blanket permission was granted, allowing the researcher unrestricted access to the schools during regular working hours. Upon arrival to a school the researcher would check in at the office and would then go to any classroom where the computers were in use. The teachers were informed that the researcher would be coming and going during the months of the study, but the teachers would not know ahead of time when the researcher would be in their classroom. Whenever the researcher entered a classroom, she introduced herself to the teacher and obtained permission to remain in the classroom. The researcher never encountered any difficulty gaining access to any school or classroom during the study and received full cooperation from those being interviewed or observed.

Initially, the reciprocal benefit to the school district for allowing the researcher unrestricted access to the schools was to be a copy of the findings at the end of the study. The district officials felt that they would benefit from the findings of an outside observer. While the research was being conducted, however, another reciprocal benefit for the school district was free access to the researcher's expertise on the use of microcomputers for instruction. Since the researcher was the only person who was actually observing the use of microcomputers in the schools, district officials would occassionally ask the researcher how the implementation of the microcomputers was going in the schools. They would also ask for advice about future staff development or curriculum plans.

Another reciprocal benefit was the willingness of the researcher to answer any technical questions that arose about microcomputers when she was on site. This fostered positive feelings on the part of teachers and administrators toward the researcher and insured continuing access to the schools. It was understood that the research data belonged to the researcher who guaranteed the security of the data. The names used in the study were pseudonyms to protect the privacy of those interviewed and observed.

Data Collection. A major concern of qualitative research is data reliability. Qualitative data carries with it an inherent internal validity since it tends to be deep data gathered in such a way as to determine the perspective of the subjects rather than the researcher. To increase the internal reliability of this study, at least three types of ethnographic data were collected to allow for triangulation of data sources (Denizen, 1978). The three main data sources were naturalistic observations in the classrooms and computer labs, structured and unstructured interviews, and historical documents from the school district. These data were collected at the three operational levels of the district, the school and the classroom. In addition, other sources of data were computer usage figures and stages-of-concern data from the county-contracted, graduate level computer education course conducted on site at two middle schools. Data were collected from the sources shown below:

Structured interviews: There were data from nine structured interviews, six with school district staff personnel and three with the principals of the participating schools, to obtain their perspectives on the innovation, the decision-making process to adopt the innovation and the implementation process.

For each structured interview the researcher scheduled an hour-long appointment with the staff person in advance, stating that the purpose of the interview was to discuss their view of and participation in the implementation of microcomputers for instructional use in the elementary and middle schools in the school district and/or in their school. The researcher

arrived with a set of broad questions that varied according to the staff position of the respondent. The questions were general enough to allow the respondent to address themes and events regarded to be important by the respondent. The questions were asked in a conversational manner by the researcher, and the answers were recorded by the researcher with pen and paper in a narrative fashion. The researcher recorded the answers in the respondent's own words. The interviews were then typed by the researcher into field notes within 48 hours after recording them.

Unstructured interviews: Fifty-two unstructured interviews were documented by the researcher. Unstructured interviews were different from the structured interviews in that the respondents did not know ahead of time that they were going to be interviewed. The purpose of the unstructured interviews conducted with three principals, three school librarians, and twenty-seven teachers was to answer specific questions about how the microcomputers were being used for instruction in a school or in a particular classroom.

Unstructured interviews lasted from 5 to 50 minutes each, depending upon the nature of the question(s) and the amount of time that the respondent had available for the interview. An unstructured interview was conducted with every teacher observed, before or after the observation period, to determine the teacher's purpose in using microcomputers with the students. Several unstructured interviews were conducted with the librarians of each school since they were responsible for scheduling the use of the computers and the software. Unstructured phone interviews were also conducted with a planner from the county planning office to obtain demographic data about the county and with an official of the U.S. Department of Education to obtain national school enrollment data as the basis for categorizing the school district by size. The responses to unstructured interviews were recorded by the researcher in a narrative fashion at the time of the interview using pen and paper. The interviews were then typed by the researcher into field notes within 48 hours after recording them.

Naturalistic observations: Fifty-three naturalistic observations were conducted by the researcher in regular classrooms or the computer labs of the schools in the study. The purpose of the naturalistic observations was to determine how the teachers and students were using the microcomputers in the classrooms of the school district by documenting the kinds of interaction observed between teachers, students and computers.

The researcher went to the school district two days a week and stopped in at one or two of the three schools each day. The researcher based the observation schedule upon the microcomputer activities that were going on at each school. In two of the three schools, the teachers had to sign up for the computers ahead of time so the researcher planned in advance to see certain activities. Overall, the researcher spent 12 to 16 hours of observation in each school

and observed each kind of instructional use of the microcomputer at least once. Each observation lasted from 30 minutes to two hours for a total of 45.5 hours of naturalistic observation. The length of an observation depended upon the activities going on in the classroom being observed and the researcher's own schedule. As long as one or more microcomputers were being used by one or more students, the researcher remained to record the activity.

When the observation took place in a regular classroom, the researcher documented the other activity, if any, that was occuring in the room while the computer was being used. During an observation the researcher sat beside a microcomputer and documented the activity that occurred as the child or children used the microcomputer. In the cases where there was more than one microcomputer in a classroom, the researcher sat by each of the computers for a complete session with a child or children. (In most cases the children would be at a computer for some amount of time specified by the teacher.)

In the lab observations, the researcher first sat in the middle of the room to record the general activity and then walked around the room to record individual activity at the computer. The researcher documented the overall atmosphere of the lab and the teacher's role in managing the lab situation. For both the lab and classroom setting the research notes were taken in longhand with a pen on a shorthand pad in a narrative style.

In both the lab and classroom setting the researcher noted the type of software being used on the computer, the teacher's role, if any, in assisting the children to use the software, the children's reaction to the software and the computer, the result of the interaction with the computer, and the interaction between the children in the room while using the computer. In addition, the researcher noted any reaction on the part of the children or the teacher to the presence of the researcher and the teacher's attitude toward having the students use the computer.

For all observation sessions, the researcher attempted to remain as unobtrusive as possible. However, the teachers occasionally asked the researcher questions since the teachers considered the researcher to be a computer expert. When doing observations in the computer lab setting, the teachers occasionally asked the researcher for assistance with students since several students would be asking for help at the same time. In such instances, the researcher assisted the teacher and then returned to recording the field notes. All such instances of researcher intervention were documented in the field notes. The researcher typed up the field notes into a narrative format within 48 hours from the time the observation took place. When typing the field notes, the researcher added other details about the observation that were fresh in her mind.

Use of Key Informants: A teacher was identified by the researcher in each of the three schools to be a key informant. In each case the teacher chosen was highly motivated and positively disposed toward the use of microcomputers for instruction in the classroom. In each case the teacher chosen was eager to speak to the researcher about the computers. In the middle school the home economics teacher was chosen since she was experimenting with computer uses beyond the prescribed home economics curriculum. She had taken the computer course the previous semester. At the large elementary school a fourth grade teacher was chosen since she was using the computer in the greatest variety of ways of the teachers in her school. She was enrolled in the computer course at the time of the data collection and had taken the inservice training at her school. At the small elementary school the Chapter I teacher was chosen since she was using the computers with her students more than any other teacher in the school. She had taken a district-sponsored BASIC programming course and the inservice training provided at her school. Numerous informal interviews and observations were conducted with the key informants at each school to determine if there was any common pattern to be observed among these computer enthusiasts.

Content analysis of historical documents: The historical documents included school board minutes, district planning reports, reports produced by school staff, demographic data and curriculum and course materials. They were examined for policy statements, goals, plans, budget allocations and concerns related to microcomputers.

Computer usage statistics: These were compiled by the researcher from the librarians' sign-out logs for the software and hardware. They were used to establish patterns and levels of use of the microcomputers.

Stages-of-concern data: These data were gathered from the participants of county-contracted, graduate level computer education courses directed and taught by the researcher. The Stages-of-Concern Questionnaire (SoCQ©) was used to measure the stages of concern felt by an individual toward an innovation using the stages-of-concern taxonomy: awareness, informational, personal, management, consequence, collaboration, and refocusing (Hall, George, & Rutherford 1979). In this study the SocQ© was used to measure the levels of concern felt by adminstrators and teachers toward microcomputers.

Data Analysis. The study was designed to allow data analysis within a three by three matrix. The six types of data collected were used to inform the components of the data analysis matrix shown in Figure 1.

Data type:

1. Structured Interviews
2. Unstructured Interviews
3. Naturalistic Observations
4. Historical Documents
5. Computer Usage Statistics
6. Stages-of-Concern (SocQ) Data

	Operational unit:		
Factor:	*school district*	*school*	*classroom*
institutional structure	1, 4	1, 2, 4	2, 3, 5
innovation characteristics	1, 4	1, 2, 4, 5	2, 3, 5
individual concerns	1, 4	1, 2, 3, 6	2, 3, 6

Figure 1. Data analysis matrix with related data.

The data were analyzed using several methods. There were over two hundred pages of field notes from the ethnographic interviews and the observations. There were data from 138 stages-of-concern questionnaires (SoCQ) and four sets of computer usage figures. There were a dozen historical documents To evaluate this large volume of data, the field notes were coded into a computerized data base.

Coding the Ethnographic Data. The ethnographic field notes were typed into computerized data files for easy retrieval of information during data analysis. They were also coded into the computerized data base program **FileMaker** on a 512-K memory Macintosh computer to allow the researcher to determine the distribution of the ethnographic data and to find occurrences of common themes (Gillespie, 1982). A record was established in the data base for each unstructured interview or naturalistic observation with staff members or children. Ninety-eight records were created from the fieldnotes. The fields in each record of the data base were:

1) **fn:** identification number of source field notes;
2) **site:** site of the interview or observation;
3) **date:** date of the interview or observation;
4) **name:** name of person(s) interviewed or observed;
5) **title:** title of person(s) interviewed or observed;
6) **concerns:** concerns of person(s) interviewed or observed;
7) **use:** use of the microcomputer classified by CAI (computer-assisted instruction), data base use, word-processing, simulations, LOGO programming, computer literacy instruction or other;
8) **intervene:** intervention by researcher and what kind;
9) **type of data:** unstructured interview or observation;
10) **time:** duration of the interview or observation;
11) **attitudes:** toward the microcomputer of interviewed or observed person(s).

Distribution of the Ethnographic Data: Once the data base was created, a profile of the ethnographic data was developed by doing searching and sorting based upon the various fields. The distribution of data by type and site was determined.These data were collected in the central office and three schools, identified by the pseudonyms:

a) District - the central office staff
b) Longfellow Middle School - the middle school
c) Crestwood Elementary School - the smaller elementary school
d) Fairview Elementary School - the larger elementary school

The distribution of data collected by source, site and kind of contact was calculated using the computerized data base to produce the table shown in Figure 2.

location:	*structured:*	*unstructured:*	*observation:*	*total:*
District	6	1	0	7
Longfellow	1	19	16	36
Crestwood	1	15	15	31
Fairview	1	18	22	41
	9	53	53	115

kind of contact:

teachers: 45 students: 53 principals: 6 librarians: 4

Figure 2. Distribution of ethnographic data.

Within each site, data were collected from the staff shown in Figure 3. The distributions by computer usage and attitudes of participants were also determined. The computer usage figures were tabulated into four tables and used as an indication of the level of usage of the innovation. The data from the individual SoCQ's were aggregated into composite profiles by semester to show in each of the seven stages of concern the overall levels of concern about microcomputers by participants in a district-sponsored computer course for teachers and administrators.

District:	number of interactions:
assistant superintendent of instruction	1
director of planning	1
supervisor of instructional services **	2
supervisior of special education **	1
director of vocational education	1
supervisor of home economics **	1
School 1: Longfellow Middle School	
principal: Mr. Jones **	1
librarian **	2
teachers:	
Mrs. Burton (Home Economics) *, **	**6**
Mrs. Riseling (Math) **	1
Mrs. Lee (LD)	2
Mrs. White (English) **	1
Mrs. Todd (Remedial Reading) **	1
in school restriction teacher	2
Miss. Lincoln (Language Arts) **	3
Mrs. Gray (Music) **	2
8th grade math teacher **	1
School 2: Crestwood Elementary School	
principal: Mr. Smith	3
librarian	2
teachers	
Mrs. Johnson (Chapt.I) *, **	**5**
Mrs. Jackson (lst) **	2
Mrs. Black (3rd)	1
Mrs. O'Connell (4th)	1
Mrs. Gordon (5th)	2
physical education teacher	1
School 3: Fairview Elementary School	
principal: Mrs. Engle	2
librarian **	2
teachers:	
Mrs. Merlin (K) **	2
Miss Lang (lst)	1
Mr. Wilson (lst)	1
Mrs. Harrison (2nd)	1
Mrs. James (2nd)	1
Mrs. Hogan (2nd) **	1
Mrs. Green (3rd) **	1
Mrs. Washington (4th) *, **	**5**
Mrs. John (4th)	1
Mrs. Emory (5th) **	3
Mr. Watson (5th)	2
speech therapist **	1

*** key informant**

** participated in a computer course

Figure 3. Staff involved in the data collection (with pseudonyms used).

Limitations of the Study

There were a number of limitations to be considered when using the field-based case study methodology within the qualitative research paradigm. A pre-defined, tightly constructed research question was sacrificed since research questions emerged while data were being gathered. Thus, the questions were driven by the data, rather than the data collection being driven by the questions. In addition, there were no independent and dependent variables defined to show cause and effect, and there were no measurable results to be shown from such a study. Instead there were descriptions of characteristics, attitudes, concerns, decison-making, institutional changes, and classroom interactions, from which emerged a sense about what the implementation of microcomputers for instruction meant to the school district in the study. What was sacrificed in statistical elegance was hopefully gained in insight.

There were specific problems that could arise from a field-based, case study methodology. The problems of external validity and reliability had to be considered before an attempt could be made to generalize from this case study. What assurance was there that the implementation of microcomputers in the school district in the study was representative of the experience of other school districts?

Past research in this area (Kennedy, 1979) had shown that generalization was possible from case to case, rather than across the population, with a case study. If the characteristics of the school district being studied and its implementation process were described with great enough care, then the results could be used on a case by case basis by decision-makers in other school districts similar to the school district in the study. The power of this type of ethnographic, case study research was that the data were thick enough to be relevant to similar cases, even if they could not be generalized across the population.

A different type of generalization, the naturalistic generalization, would emerge as a result of accumulated experience. Such naturalistic generalizations would provide a way of "knowing how things are" to guide future action in similar cases (Stake, 1978). This problem was specifically addressed by Bass in the case studies describing the implementation of alternative schools in four school districts:

> "In understanding this study of alternatives, we were primarily concerned with accurately describing the implementation process in a few districts. We felt that, by providing a qualitative sense of the factors that are important in [implementation], these case studies could help educational policymakers interested in developing educational options in other settings and suggest hypothesis for future research" (Bass, 1978, p. 17).

When using naturalistic observation data, there were several types of bias that affected the validity and reliability of the data. Riley (1963) described two types of bias, control effect and biased-viewpoint effect. The control effect was caused by the often unsystematic nature of the data collection in participation observation. The biased-viewpoint effect was related to the fact that "the instrument (the human observer) may selectively expose himself to the data or selectively perceive them, and worse yet, shift over time the calibration of his observation measures" (Webb et al, 1981, p. 199). The problem with biased-viewpoint was also described by Naroll and Naroll who wrote of the observer's "tendency for 'exotic data.' The observer is more likely to report on phenomena that are different from those of his or her own society or subculture than on phenomena common to both" (1963, p.24).

In this study the researcher/observer attempted to overcome control bias by using a systematic strategy to record the activity during each observation. The biased-viewpoint effect was overcome to some extent by the observer observing in any classroom where the computers were present on a given day, rather than selecting which room to observe. The problem of exotic data was minimized in this study since the classroom setting was a familiar subculture to the observer.

Another problem frequently encountered with ethnographic research involving naturalistic observation was that of the insider/ outsider relationship between the researcher and the subjects studied (Merton, 1972). In this study a balance had to be maintained by the researcher between her role as an "outside expert" and her role as an insider accepted into the school district to do observations in the classrooms. The researcher was perceived to be both an outsider and an insider - an outsider due to the researcher's position as a member of the Computer Science faculty at a local university and an insider due to the researcher's involvement in teacher education courses in the school district over a period of 18 months prior to the research. Therefore, many of the teachers and administrators already knew the researcher or had heard about the researcher prior to her presence in the schools. This enabled the researcher to be accepted into the classroom settings without being seen as a threat by the teachers. It was the researcher's reponsibility to maintain her perspective as an outsider when collecting and analyzing the field data.

In addition to the insider/outsider issue, there was also the balance to be maintained between rapport/overrapport with observed subjects. A good rapport with observed subjects was necessary to insure continued access to sites; however, the researcher sometimes encountered the problem of overraport (Everhart, 1977). It was possible that the observed teachers would change what they are doing in their classroom so that the researcher would have something to "see," or they would request the researcher to come at certain times to offer them

suggestions or help with what they were doing. The researcher was careful to document all instances of requests for help with or advice about the microcomputers in order to describe the possible impact the researcher had on the study.

Researcher Intervention: Researcher intervention was cited as a particular pitfall of ethnographic research since the researcher usually becomes closely involved with the environment under study (Everhart, 1977; Merton, 1972). Because the researcher in this study was viewed as an expert and the innovation in the study was viewed as highly technical and complex, those being studied would call upon her expertise. Since a personal rapport had been established with many of those interviewed and observed, it was difficult for the researcher to refrain from making suggestions that she knew would help them. Researcher intervention in this study was defined to be any effect that the presence of the researcher had upon the research environment. There were 37 instances of researcher intervention documented in the 98 sets of fieldnotes and one instance of researcher intervention during a structured interview. The type and frequency of researcher intervention documented in the fieldnotes were:

a) originated by the person being interviewed or observed:
   1) answering technical questions for teachers (15)
   2) answering questions for students in the lab setting (5)
   3) answering the question of an individual student (4)
   4) teachers making a change in the lesson because researcher was present (4)
   5) teacher asking advice about a lesson (3)
   6) Media Specialist asking advice about the implementation plan (1)

b) originated by the researcher : making suggestions to teachers about a lesson or use of software (5)

Due to the high anxiety felt by many teachers when using the computers, some teachers were relieved to see the researcher arrive to observe and would ask her technical questions about the computers or the software. In other instances, teachers became nervous when the researcher arrived. They stated that they were just getting started on the computers, and their lessons were not well-formulated yet. They would ask for the researcher's advice about how to improve the lesson at the end of the class. In the lab settings where there were many students using many computers at the same time, the teachers would sometimes ask the researcher to help answer the students' questions. Sometimes individual students would make comments or ask the researcher questions as she sat beside the computer to observe them. The data revealed that the key informants asked the researcher for help more frequently than other teachers. This would suggest that there was a positive relationship between researcher intervention and the familiarity felt by the respondents toward the researcher.

Examining Major Themes

From the data gathered from the six sources, several conflicting major themes emerged: resistance to innovation, strong grassroots support for microcomputers, fear of microcomputers, high motivation to use microcomputers, the influence of early adopter school districts, and the importance of the individual in the implementation process.

Resistance to Innovation

Resistance to innovation was evidenced at all levels of the school district. The Assistant Superintendent for Instruction was highly suspicious of educational innovation in general as he commented, ""I have had a lot of reservations about using computers in schools. I did not consider them to be the solution to all educational problems. I view the computer as a tool to save time and labor if used properly. I remember what ETV, the overhead projector and 16 mm film were supposed to do for education!" (structured interview, May 5, 1986).

As a result of reservations felt by him and others, the implementation process proceeded cautiously. Other central office staff wanted to wait for the technology "to settle down" before jumping in too soon. For example, the Director of Vocational Educational stated that they should have waited one more year before putting the microcomputers in the other three high schools. "There were a lot of frustrations with computers during the pilot year. It takes two years for the dust to settle. Some of high school teachers loved the Radio Shacks and some hated them" (structured interview, April 14, 1986). The implementation of the Apple IIe microcomputers in the 18 other elementary schools after the pilot schools was delayed a year and rescheduled for the two-year period 1986-1988, rather than taking place during the 1985-86 school year as was originally planned.

Several supervisors expressed reservations about turning the innovation loose with teachers without the proper curriculum in place. There was the concern that teachers might use computers in an educationally inappropriate way. One supervisor was concerned that teachers would use computers to teach material beyond their grade level, thus distrubing the curriculum content for following years.

In the middle school many teachers were able to resist the innovation of microcomputers since they were not required to use them in their subject areas. Some teachers were required to use the computers, and others did so voluntarily. However, the majority of middle school teachers did not attempt to use the microcomputers in their classrooms.

In the elementary schools, however, there was strong pressure from the principals for all teachers to use the microcomputers with their students at some time during the year. At the

time of the observations, most of the teachers in the two elementary schools had either used the microcomputers or were in the process of doing so. Here, resistance to innovation was in a more subtle form. In most cases, the primary teachers (grades K, 1,2, and 3) used one or two microcomputers as an activity center in their classroom along with numerous activity centers. The upper grade teachers(grades 4, 5, and 6) most frequently used the one or two microcomputers in the classroom as an enrichment or remediation activity separate from the regular classroom work. In both cases, the teachers were simply using the microcomputer as an extension of what they were already doing in the classroom, rather than using the microcomputer as a true innovation. Only a few middle school and elementary teachers took their students to the computer lab to try wordprocessing, data bases or programming. These three activities required a change in the way the classroom was managed and a change in the way regular subjects were taught - for example, using wordprocessing as a writing tool or using a data base to organize social studies data.

Strong Grassroots Support for Microcomputers

Throughout the data was evidence that the momentum for implementing microcomputers in the school district began as a grassroots movement. Parents pressured the School Board, the principals and the teachers through the parent-teacher organizations to get computers into the schools. As a suburban school district bordering on a high-tech metropolitan area, parental concern was expressed that their children were being left behind. Several computer enthusiasts who were teachers also pressured the principals and central office staff, and one teacher even brought his own computer into school for students to use. There were parents, central office staff, principals and teachers who felt that if the school district didn't get started with microcomputers soon, the technology would advance beyond them.

According to one principal, once the microcomputers were in the schools, parents then lost interest in the issue. As long as they could see the microcomputers when they walked through the schools and they heard from their children that they were using the microcomputers, parents were not concerned about how the computers were being used. The visibility and use of the microcomputers satisfied parental concern, and the complex, technical nature of microcomputers acted as a barrier for their further involvement with microcomputers. Parents occasionally still complained if they thought their child was not getting to use the microcomputers enough, according to the Assistant Superintendent for Instruction.

Fear of the Microcomputer

The microcomputer has been described as the most anxiety-producing innovation among teachers that has been studied in the past two decades (Quinsatt, 1981; McNeil, 1983; Meister, 1984). Because the microcomputer is expensive, it is also an anxiety-producing innovation for administrators who are afraid of making the wrong decisions in selecting hardware, software, and strategies for implementation. The Assistant Superintendent for Instruction expressed fears about rapidly changing technology that would make equipment purchases obsolete. He was also afraid of making serious educational mistakes by moving too fast with microcomputers.

Teachers were afraid of the complex, technical nature of the microcomputer. They were afraid of not being able to use the software and of not being able to understand how computers work. They were afraid that their students would know more than they did about computers. They were intimidated by how expensive the computers were and were afraid that they or their students would damage them. One teacher was afraid to put a diskette in the computer or take it out for fear of ruining the diskette. She always had one of her students do it for her. Another teacher stated that the inservice course on computers was the most frightening course she had ever taken. She eventually completed the course with flying colors and became a computer enthusiast afterward, but during the course she was often on the verge of tears. Many teachers echoed the same fears about using the microcomputers for the first time.

High Motivation to Use Microcomputers

The high motivation expressed by many to use the microcomputers was contrasted to the fears expressed by many staff members and teachers in the school district. In some cases this high motivation was expressed by those who had initially had strong fears about microcomputers, and in all cases the teachers' motivation was related to the motivation that the computers instilled in their students. Teacher comments about motivation to use microcomputers follow:

"I think the computer is a great incentive for students - they work harder to get a turn at the computer." (remedial reading teacher)

"The children love the computer and never get tired of using it or of doing the same software over again." (learning disabled teacher)

"It is a good experience for the students. The kids enjoy the computer and [wordprocessing] seems like real work to [the teacher], not a computer game. The students have a real satisfaction seeing their work printed out." (language arts teacher)

"I like using the computers with these students since they are more interested in this unit

than any other method I have tried." (music teacher)

"I am very pleased with the results. The children enjoy the computers and are very careful with them." (second grade teacher)

"The children are excited about having the computers in the room and are always eager to have their turn." (first grade teacher)

"I am especially excited about using computers to do wordprocessing with LD [learning disabled] students since they can see and correct their spelling mistakes more readily on the screen. They get so much satisfaction from printing out their work." (learning disabled teacher)

In most cases the students were attentive and purposeful when working at the computer and were not distracted by activity in the room around them. Most students displayed confidence when using the computers. Typical students comments were:

"This is so excellent!"

"Right on!"

"I got it right!"

"It's my turn now."

"Do we get to use the computers today?"

Influence of Early Adopter School Districts

One of the issues of interest when studying the implementation of an innovation by a majority adopter was whether there was evidence of influence from the experiences of innovators and early adopters (Hall, 1981; Rogers, 1983). Referring to the early adopters, the Assistant Superintendent for Instruction stated, "I did not want to jump on a band wagon as many other school districts have done." He noted that some school systems that jumped onto the computer band wagon were starting to pare down their computer expenditures. His question was always, "What was being eliminated in order to have time for computers? I had to see a justification for the tradeoff" (structured interview, May 5, 1986).

The Computer Advisory Committee examined at least seven early adopter school districts before presenting its first recommendations to the School Board in August, 1982. The report stated, "Fortunately, [this area] provides many opportunities for learning how computers have been and are currently being utilized in a school environment. Several school districts have been involved with instructional...computer usage for over a decade." They made site visits, carried out telephone interviews, and read case studies in the literature to avoid the mistakes made by the early adopters. By reading the literature, they learned the value of approving one computer brand to be used in the district schools to insure compatibility among the schools.

Many of the innovator and early adopter school districts had allowed individual schools to buy different computers, resulting in a chaotic proliferation of many brands and software packages. It became difficult for those districts to develop a standard computer curriculum. From one neighboring school district they saw the mistake of getting a "good deal" on the wrong hardware. From another school district, they saw the value of intensive, computer-assisted instruction used to increase basic skills.

As a result of the experiences of another school district, the committee recommended against emphasizing programming in the middle and elementary schools as had been done by many innovator school districts. They also recommended against teaching the computer as a separate subject, except at the high school level, but rather to take the approach that had evolved over the previous five years to integrate the computer as a tool and a learning enhancer in other subjects. They were told that there was good software and bad software, and that a software review committee was essential to evaluate and to organize the software by grade level. From all the successful school districts came the model of a district computer coordinator needed to coordinate the computer acquisition, training and software distribution. However, the most important lesson learned from the literature about the early adopters was to establish educational goals first, then choose the software and hardware, and institute curriculum modification and teacher training while the equipment is being installed. The Assistant Superindentent of Instruction stated that he was a firm believer in curriculum first, then equipment and inservice training at the same time.

The central office staff realized from the beginning that the implementation process was multifacted, involving curriculum changes, staff training, selection and preparation of secure facilities, equipment purchases, software distribution, and finally equipment maintenance. So they proceeded slowly, implementing the plan in stages from the high schools to the middle schools to the elementary schools. The implementation process began in Fall, 1985 and was planned to be carried out through the Spring, 1988. The Assistant Superintendent for Instruction said, "By taking our time, we hoped not to repeat the mistakes others had made. We read the literature, watched the computer market, and proceeded with great caution" (structured interview, May 5, 1986).

Importance of the Individual in the Implementation Process

Even more important than the institutional structure and the innovation characteristics, the individual has proven to be the key factor in implementation in previous studies (Bass, 1978; Berman & McLaughlin, 1976, 1978; Hall, 1981; House, 1974). Implementation of an innovation leading to institutionalization cannot take place unless the individuals involved are

willing and able to change. Since the classroom teacher is the prime implementor of an educational innovation (McLaughlin & Berman, 1977), the reactions of teachers to microcomputers for instruction have proven to be especially important in their implementation (McNeil, 1983; Meister, 1984). In this study the attitudes and concerns of individuals at each operational level were examined.

Attitudes of Individuals: The attitudes of most adminstrators interviewed were strongly positive toward the microcomputers, and they viewed computers as a necessary addition to the curriculum of the school district. When asked if she was in favor of acquiring the microcomputers, the Supervisor for Vocational and Special Education stated, "Absolutely! I'm a pusher. I work hard to motivate my teachers. Some say I push too hard, but I'm twisting arms to get them all to use the computers" (structured interview, April 7, 1986). She also stated that the feedback from her teachers was positive and that she was expecting an increased enrollment as a result of using computers in the home economics curriculum. This positive response was echoed by other central office staff members.

The principals of the three schools expressed positive attitudes about having computers in their schools. The principal of Longfellow stated that he had been pushing for computers at principals' meetings for the past five years. He used computers to do his own work, and he was very "enthusiastic" about the computers "finally" arriving for instruction. He was personally training his secretarial staff to use the administrative computer in the office, as well encouraging teachers to develop computer units to use in their disciplines. The principal of Fairview was "delighted" to have the computers in her school. She was especially proud of the teachers for using the computers to produce their entire Self Study Report (required every five years for state accreditation). She felt that this experience had brought the staff closer together and made everyone more comfortable with the computers. The parents of her school were also enthusiastic about the computers and several served as computer aides. The principal of Crestwood stated that he was "pleased" his school had been chosen to be a pilot school and credited the teachers' enthusiasm over computers as the impetus for acquiring them.

Similarly, most teachers interviewed expressed strongly positive attitudes toward the computers. Many of their attitudes were based upon their students' reactions to the computers. Typical comments were:

"I think computers are the best thing to happen to add spice in the classroom." (home economics teacher)

"I loved the computer course, and I'm now hooked on computers. I've gotten the word out to all of my colleagues about how useful the computers are with my students." (speech therapist)

"I bring the computer into the classroom every chance I get. . . sometimes, I have to fight for it." (Chapter I teacher)

"I would like to be able to have a computer in my room all the time as a permanent center. I have to be careful not to be too selfish and let other teachers have a turn using them! I bring the computers in whenever I can get my hands on them. When they are here, every child wants a turn that day on them." (second grade teacher)

Two teachers admitted that they were using the computers with their students because they were required to, but that they did not personally like computers that much.

All of the students observed showed enthusiam for using the computers, except for one sixth grade remedial reading student who stated that he was bored because he hated doing spelling drills and the computer game was too slow. Some of their comments were:

"Look at the picture I drew."

"I finished the race."

"I don't have to look at my fingers anymore!"

Concerns of Individuals: The ethnographic data were analyzed for the stated concerns of individuals at each operational level of the school district. Many concerns about microcomputers in instruction were expressed during the interviews and observations. Many of the central staff, adminstrators and teachers expressed concern over insuring an equitable distribution of computer time among all students The following concerns were expressed by the central office staff:

a) the cost of obsolecence and maintenance of computers,
b) having the microcomputers drive the curriculum, rather than vice versa,
c) complexity of the overall coordination of a technological innovation,
d) ongoing teacher training that would be needed,
e) having sufficient staff for technical support, and
f) having sufficient software and hardware to support the demand.

Within the schools the principals also expressed concerns about the microcomputers. Their concerns were related to:

a) keyboarding skills - at what level and how much emphasis (Crestwood, Longfellow),
b) increasing parental involvement (Crestwood and Fairview),
c) computer literacy for all students (Crestwood, Longfellow),
d) all teachers and children being comfortable using the computers (Fairview),
e) the appropriate age for children to use computers (Crestwood),
f) acquiring more microcomputers (Fairview),
g) maximum utilization of microcomputers (Crestwood), and

h) evaluating the use of microcomputers (Fairview).

The librarians at each school were primarily concerned about recording the use of the software and hardware since they were responsible for maintaining circulation records. At one school the librarian was concerned about teachers using the software without properly checking it out, thereby making her circulation records for the state inaccurate.

As the primary users of computers with the children, the teachers expressed many concerns about the microcomputers. Most of the teachers interviewed had at least one concern, which were predominantly related to time, software and classroom management. The concerns with their frequency of occurence found in the field notes were:

a) time-related concerns such as

1) insufficient time to prepare lessons and handouts for the computer usage (7),

2) insufficient time for each child to have a turn (5),

3) completion of the required material in the computer literacy unit within the specified amount of time(3), and

4) insufficient time to complete required objectives and to use the computer (1);

b) software-related concerns such as

1) uncertainty about how to use some of the software (8),

2) not enough appropriate software (5),

3) inadequate documentation with some of the software (3), and

4) not enough copies of the software for each student (3);

c) classroom management-related concerns such as

1) maintaining discipline while in the computer lab (6),

2) noise level of students in the computer lab (5),

3) answering students' questions while in the computer lab (5),

4) damage to the hardware or software by students(4), and

5) matching the right software with the right students (4);

d) and other concerns such as

1) nervous about being observed (5),

2) keyboarding skills of the students (3),

3) anxieties about the inservice computer course (3), and

4) technical questions about the hardware (2).

The students also voiced or exhibited some concerns about the computers as follows:

a) getting the correct answers (14),

b) knowing how to use the software (10),

c) finding the right key on the keyboard (6),

d) finishing their task on the computer (5),
e) getting their turn on the computer (5),
f) making mistakes (2), and
g) getting the highest score on a game (2).

Implementation Leading to Long-Term Institutionalization

An important question to be addressed by this study was whether the implementation would lead to long-term institutionalization of the innovation of microcomputers for instruction by the school district. If implementation is viewed as an adaptive process positioned in the center of a three-way interaction between institutional characteristics, innovation characteristics and individual concerns shown in Figure 4, all three factors must be working together to produce institutionalization.

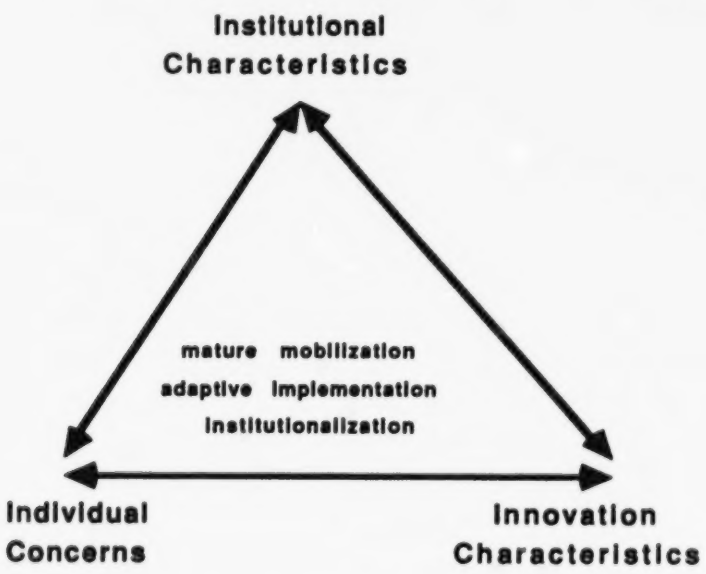

Figure 4. Context for Implementation

It was concluded from the data that the school district exhibited the adaptivity to innovate described by Berman and McLaughlin as developmental (1979), in that there was evidence of lower levels of decision-making, shared resonsibility, encouragement of risk-taking, sense of professionalism, high staff morale, and the presence of long-range planning (Bozeman, 1984).

There was a stated commitment to continue the equipment purchases, staffing, teacher training, curriculum development and teacher participation called for by a revised implementation plan. These were the institutional characteristics that have contributed to adaptive implementation leading to institutionalization of innovations in past studies. Similarly, the innovation of microcomputers for instruction had clear goals and active principal support, was demanding and highly visible, and required specific, ongoing training. These were the innovation characteristics that have contributed to adaptive implementation leading to institutionalization of innovations in past studies.

Although the teacher concerns data revealed a high evel of personal anxiety, the profiles exhibited the characteristics of positively-disposed computer users, open to becoming more active users of microcomputers for instruction. There was evidence of increasing risk-taking and experimentation on the part of teachers using the microcomputers as the first year of implementation progressed. All of the individuals interviewed stated future plans and goals for continued use of the innovation and expressed the opinion that the computers were going to become an integral part of the educational delivery system of the school district in many different ways. There was indication that individual concerns were starting to move away from self-directed levels of concern to the higher task-directed and impact-directed levels of concerns by the end of the first year of implementation (Martin & Heller, 1985). The data revealed that the interaction of the three factors of institutional characteristics, innovation characteristics, and individual concerns of this particular school district were producing a mature mobilization leading to an adaptive implementation process. There was sufficient evidence to conclude that these factors would eventually lead to institutionalization of the innovation.

Conclusions

Microcomputers offer the potential to greatly enhance the educational delivery system, but due to their complex technical nature, this potential has not always been realized. The prevalence of the use of CAI found in this study and in other studies suggests that educators are adapting the innovation to the delivery system, rather than adapting the delivery system to take advantage of the full potential of the microcomputer. The reason that teachers have so many problems integrating the open-ended uses of computers, such as wordprocessing, data bases, or programming, into their classrooms is that these uses require risk and real change on the part of teachers. Such uses may require the acceptance of some noise and confusion in the classroom on the part of administrators and teachers. They may also require the use of trained aides to facilitate the use of many computers by many children at the same time.

Since the institutionalization of an educational innovation takes place within the context of the local school district, the full potential of microcomputers can be realized only if all operational levels work together to adapt microcomputers into the instructional program. The centralized planning and decentralized decision-making found in this study were essential to the acceptance of the microcomputers at all operational levels.

The broad base of support for microcomputers created by public pressure, administrators, and teachers was fueled by a common sense of urgency about the expanding role of microcomputers in society. However, once the computers were in place the public was content to let the educators figure out what to do with them. The importance of the visibility of microcomputers as an innovation cannot be overemphasized. As long as parents could walk through the schools and see children using microcomputers, they were satisfied that their children were becoming computer users and very few of them questioned how the computers were being used. The visibility of microcomputers positively affected the public perception of microcomputer use in the schools, and the complexity of microcomputers negatively affected the public participation in the implementation process.

The key actor in the process of implementating microcomputers for instruction in a school district was the classroom teacher. Although all of the principals expressed support for the microcomputers, it was the classroom teachers who determined whether the innovation was adopted pro forma or whether the instructional process was adapted to accommodate the innovation. Collectively and individually, they exhibited high levels of personal concern that would have to be dealt with before true adaptation could take place. The teachers who were using the computers to help them do their job better, such as create lesson plans or assignments, were the most enthusiastic users of the computers with their students. This would suggest that the best way to bring about change in the classroom with microcomputers would be to teach teachers how to use microcomputers for their own personal use, before teaching them how to use them with students.

Similarly, the teachers that had been involved in developing the computer literacy unit and the software correlation guide were also very enthusiastic about the microcomputers because they had a sense of ownership in the success of the implementation process. This reemphasizes previous findings that the more teachers are involved in the implementation process, the greater is their acceptance of the innovation, and the higher is their morale.

The importance of the role of teachers in the implementation process pointed out the need for teacher training programs on microcomputers beyond the first course. Teachers need to be offered additional courses on word-processing, modeling and data bases with an emphasis upon personal usefulness of computers, new classroom management models, training parents

as computer aids, and opportunities to observe other teachers using computers with students. Teachers receiving this additional training should then participate in the development of new curriculum that calls for these open-ended uses of the microcomputers in all subject areas.

Another important factor in the general acceptance of the microcomputers by teachers was the availability and portability of the microcomputers. Some teachers were brave enough to take their students into the lab setting, but most teachers preferred to deal with one or two microcomputers in the safety of their own classrooms. In the classroom setting teachers could set up well-defined boundaries for use of the computers by a few children at a time as opposed to many students on many computers at once. A popular misconception in the past was that the scenario of one computer for the twenty-five children in a typical classroom was a difficult classroom management problem for teachers. This study showed that, in fact, most teachers were comfortable with one or two computers and twenty-five students. They became uncomfortable with many children and many computers because they lost their feeling of control over the situation. Now that microcomputers are becoming readily available in large numbers in schools, the management of many microcomputers and the use of computer lab aides will need to be a part of future implementation plans for microcomputers in instruction.

Finally, it was concluded that the factors facilitating the implementation of microcomputers for instruction in this majority adopter school district were :

a) broad based support fueled by public pressure ,

b) availability of information from early adopter school districts,

c) comprehensive, centralized planning of the entire process,

d) the size of the school district with relatively few layers of bureauracy,

e) provision of sufficient resources for hardware, software, staff development, curriculum development and technical support,

f) creation of the position of a district-wide computer coordinator,

g) selection of uniform hardware and software that was compatible with the educational goals of the district ,

h) visibility and portability of the microcomputers,

i) interactive nature of the microcomputers,

j) decentralized decision-making regarding actual use of the innovation,

k) support of the principals in each school,

l) provision of adequate teacher training and incentives to innovate,

m) enthusiasm of students for the microcomputers, and

n) high level of participation of teachers in the development of materials and curriculum.

The factors hindering the implementation of microcomputers for instruction were:

a) initial resistance toward the innovation by central office personnel,

b) concern of central office personnel about moving too fast,

c) the complex, technical nature of microcomputers,

d) the non-obvious, open-ended nature of microcomputers, and

e) high levels of personal concern on the part of teachers regarding the innovation.

Although each school district is unique, these are factors that should be considered by any school district planning for future implementation of microcomputers in instruction. The microcomputer is an educational innovation that will require ongoing mobilization, implementation and institutionalization in school districts. Many insightful administrators have already recognized the iterative nature of implementing microcomputers for instruction and are growing apprehensive about the ongoing level of financial commitment required to accomplish an uncertain outcome. Other priorities are starting to clamor for resources once willingly allocated for microcomputers. The challenge in the next decade of using microcomputers in instruction will be to convince decision-makers in school districts to continue to supply the technical support, training, and incentives to teachers that will encourage them to move beyond their current delivery style and take advantage of the unique capabilities of the microcomputer. The challenge for researchers will be to provide the theoretical rationale and the practical models that will facilitate this higher level of implementation of microcomputers for instruction by school districts.

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